



Feasibility Study: Personality as a Perceptual Feature for Biosignal-Based Distress Detection (HRV derived from Clinical V-EEG).

PhD Biomedical Engineering



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Abstract

- Psychological distress is an unpleasant emotional state characterized by a range of affective, cognitive, and somatic symptoms that deviate from an individual's normal psychological functioning [1] [2].
- Artificial intelligence (AI) technologies, such as machine learning (ML) and deep learning (DL) models, have shown promise as tools for the **identification, detection, and assessment of psychological distress** [3] [4] [5].
- Psychological distress, in **clinical environments**, significantly impacts quality of life, treatment adherence, hospitalization duration, and consequently increases healthcare costs [6] [7].
- This study aims to **validate the feasibility of identifying psychological distress in a clinical setting** (specifically, during a patient's hospitalization for V-EEG monitoring).
- Characterize the participant's **personality traits** and examine the correlation between these traits and levels of distress.
- Future ML/DL models for **distress identification in clinical environments must integrate personality traits**[8] [9].



(Fig.1)
(Image AI generated-ChatGPT)

Objectives

- 1) **Validate the technical feasibility of a multimodal approach in a clinical setting.**
- 2) **Generate a robust hypothesis for the development of clinical tools capable of detecting psychological distress while integrating personality traits.**

Methodology

- Observational and longitudinal study**, one participant diagnosed with epilepsy was selected during a one-week hospitalization for V-EEG monitoring.
- Psychological scales** (HADS – depression and anxiety, Kessler Scale – psychological distress, and NEO-FFI60 Personality Inventory) were administered at three different time points.
- Physiological signals** (ECG, EEG, EOG, and EMG) were collected at four different time points, with the first time point (M0) serving as the baseline measurement.

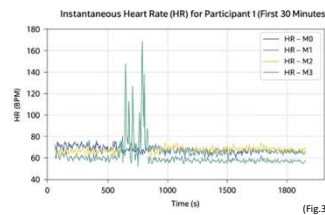
Baseline Physiological Signals



~30-minute sessions

Collection of psychological and physiological data

(Fig.2)



(Fig.3)

Psychological Data

(HADS/Kessler/Neo-FFI 60)

Moment	Total HADS-A	Total HADS-D	Total HADS	Total Distress
M1	12.00	7.00	19.00	13.00
M2	5.00	1.00	6.00	18.00
M3	6.00	1.00	7.00	14.00

Neo-FFI 60

Neuroticism	Extraversion	Openness to Experience	Agreeableness
23 (23)	20 (29)	14 (6,3)	17 (32,4)

(Fig.4)

Pre-processing and Processing of Physiological Signals

Signal Acquisition

System Configuration	
System	V-EEG (VideoElectroencephalography)
Channels	77 EEG channels +1 ECG + 1 EMG +1 EOG
Amplifier	Quantum 256 (Natus Medical)
Sampling Frequency	16 kHz
Bandwidth	0.01 - 4 kHz



Signal Processing

- A/D Conversion**
Transformation of the analog signal into a high-resolution digital signal
- Filtering**
High-pass filter (removes DC component) and low-pass filter (eliminates high-frequency noise)
- Noise Reduction**
Advanced algorithms for artifact and interference removal
- Software**
NeuroWorks for digital filtering and generation of EDF (European Data Format) files

Python Libraries

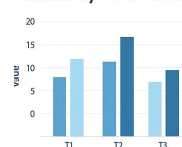
Python	Pandas	Numpy	Neurokit2
Scipy	Scipy	Neurokit2	Seaborn

(Fig.5)

Results

Psychological Distress

Scales by Time Point



Variable	Total Distress
HRV_SDNN	0.81
HRV_RMSSD	0.89

Main Observations

- Strong positive correlation between **HRV_RMSSD** and total distress level ($r = 0.89$)
- Significant correlation between **HRV_SDNN** and total distress ($r = 0.81$)
- Distinct correlation patterns across different distress measures

Personality (Neo-FFI)

Neuroticism – Extraversion – Agreeableness – Conscientiousness – Openness

(Fig.6)

Conclusion

- This case study **validates the technical feasibility of extracting HRV from V-EEG data and demonstrates a strong Distress ↔ HRV convergence in the participant.**
- Personality traits may influence how psychological distress is perceived** and, consequently, whether and how this perception translates into changes in the autonomic nervous system (ANS) - and therefore, in HRV.

Next Steps

- Transition from feasibility demonstration to hypothesis validation in larger samples.**
- Develop machine learning (ML) algorithms capable of **integrating personality dimensions into distress detection.**
- Create objective detection tools able to **identify psychological distress, in clinical environments**, that often escapes the subjectivity of clinical observation and self-report measures.

Acknowledgements

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References:

